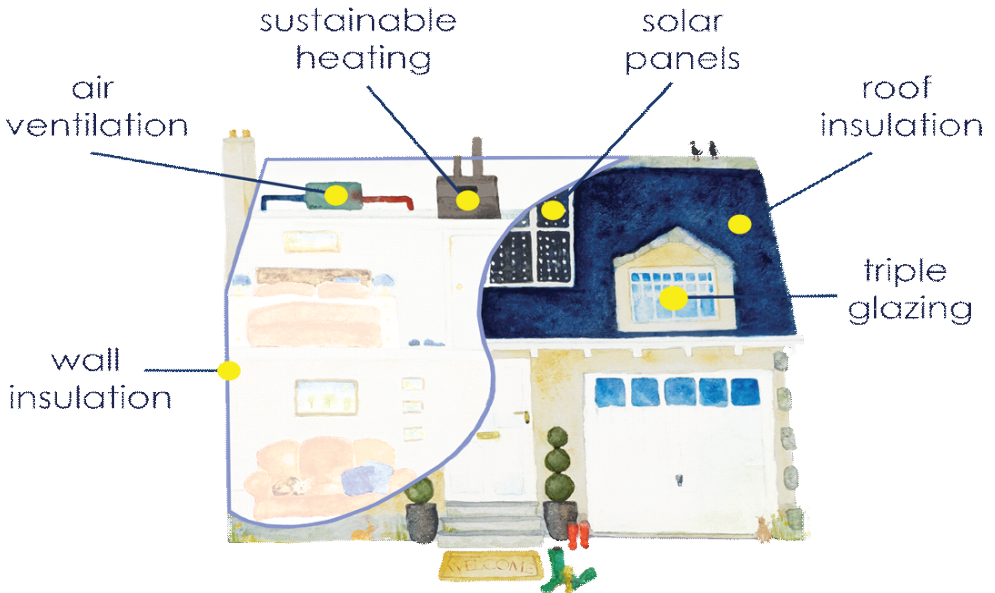


Our Future Homes

A Guide to Retrofit and Heat Pumps



This booklet has been written by **Udny Climate Action** and **Zero Carbon Daviot**.

Thanks go to-

- **Udny Community Trust** (<https://udnycommunitytrust.org.uk>) and **Aberdeenshire Council** for funding this booklet. **Zero Carbon Daviot** provided additional finance.
- **Annie Grant** of **Art by Annie Grant** (<https://artbyanniegrant.co.uk>) for the cover diagram and cartoons.

“**Our Future Homes**” is also available on the websites of Udny Climate Action and Zero Carbon Daviot, along with an expanded version for people wanting more detail.

Disclaimer: Udny Climate Action and Zero Carbon Daviot have tried to ensure that the information in this booklet is accurate.. However there will be technical advances and changes to funding incentives as time goes on, so readers are encouraged to undertake their own investigations and obtain independent advice before taking decisions about their homes.

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Why this booklet?

Much of Scotland's housing is of older standards, lacking the quality of many of our European neighbours. Our homes account for 19% of Scotland's carbon emissions and the Scottish and UK Governments have targets to reduce this. Many of our homes are damp, draughty and have poor air quality that leads to health problems. But what are the features of an ideal house? It will:

- be as close to zero carbon as possible to help tackle climate change.
- provide a comfortable and healthy environment.
- be low-cost to heat and occupants should not experience fuel poverty.
- have a high Energy Performance Certificate (EPC) rating which will add value when it comes to selling it. An EPC A rated home sells for 14% more than a G rated equivalent and this is likely to increase.

To meet its climate ambitions, the Scottish Government is discouraging the installation of new or replacement fossil fuel boilers in areas off the gas grid from 2025. Most rural communities in the North East use oil or LPG and this will mean changing to heat pumps. To ensure that homes are warm, and that fuel costs are kept down, many also need improved insulation and other heat loss measures. The best approach is to develop a fabric-first, whole-house plan before starting any work.

This booklet describes best practice for renovation of a house. Many householders will only have the resources and time to undertake aspects of a complete retrofit. With fuel prices rising and pressure on household budgets, this may not seem like the best time to consider renovation and a new heating system. However, a retrofitted house is much cheaper to heat. We need to look to the medium term and make a retrofit plan, as described below, which can be implemented over time as opportunities allow; it can stay with the house if the owner moves on.

Udny Climate Action and Zero Carbon Daviot hope that this booklet will encourage homeowners to consider changes and give tenants useful information when discussing issues with their landlords.

Headlines

- 'Retrofitting' brings a house up to modern, sustainable standards. There are three key components: a) reducing heat loss as far as possible b) providing good ventilation c) installing low carbon heating.
- Recently built properties may only need a change of heating system, older buildings will require varying levels of work to bring them up to standard. Single measures, such as installing loft insulation or new windows, will not be enough for most homes.
- The Scottish Government target is for the majority of homes to reach a minimum energy efficiency rating of EPC band C by 2030 with all homes meeting this standard by 2033. The longer term strategy is to upgrade all homes to EPC rating B by 2040. However, we should be ambitious: we have the materials and the knowledge to retrofit homes to meet EPC band A today.

- Planning ahead is the key. Each home is unique. No one solution fits all. A retrofit plan is needed for each house. As upgrading can be disruptive, planning for full retrofit from the word go is desirable with work being spread over time as suits the householder's circumstances and pocket.
- A 'fabric first' approach is best: prioritise reducing heat loss, then consider the heating system. In this way, the latter can be correctly sized to the well insulated property and the system will be cheap to run.
- Pick your time- retrofit is least disruptive when work is already needed, such as when moving house, replacing an old boiler or refurbishing the interior.
- Doing your own research and getting independent advice is essential, preferably from a qualified retrofit co-ordinator.

Quick Wins

While most of us have already taken these actions, they are first stop, money saving options:

- Ensure that loft insulation has a minimum depth of 27cm (while making certain that ventilation isn't blocked).
- Turn down heating to the lowest comfort level.
- Ensure all light bulbs are LEDs.
- Draft proof gaps.
- Use thick curtains and keep them closed after dark.
- Reduce energy use (turn off lights; avoid leaving appliances on standby; minimise use of appliances).

The Fabric of the house: a Q & A

My roofspace is insulated but what about my walls?

Uninsulated walls account for up to 30% of a home's heat loss. Depending on the type of building (timber framed, solid stone or brick, brick with cavity wall), walls can be insulated internally or externally. Many homes will have wall insulation but this will probably not meet current standards. The choice of internal or external insulation has implications for the ventilation and moisture strategy for the whole building. Where there is a ventilation cavity between the masonry wall and the internal walls, it is often safest to leave this, although some projects have successfully used cavity insulation following careful analysis.



Damp's a problem for many, isn't it?

Yes. Every building has internal and external sources of moisture. Internal moisture comes from cooking, washing and, yes, humans and pets! When a home is well insulated the air becomes warmer (that's the aim!) but this will hold more moisture. When this warm-moist air meets cold surfaces, such as windows or poorly insulated corners, it condenses, hence water on windowsills and black patches of mould. Worryingly, the process can happen inside the walls with risk to the structure of the building particularly if retrofitting is done incorrectly.

What's the solution?

The right insulation in the right place and a good ventilation system; but if you need a fix immediately, buying a dehumidifier will help.


So I must ventilate as well as insulate?

Certainly. Good ventilation will not only reduce condensation, it will improve poor air quality due to such things as carbon monoxide from wood burning stoves and various chemicals released in the home. Here's a slogan- 'Build tight, ventilate right'.

Tell me about ventilation systems.

There is a huge difference between drafts and controlled ventilation. A variety of ventilation systems are available, from simple trickle vents above windows and extractor fans to centralised mechanical extraction or "Mechanical Ventilation with Heat Recovery" (MVHR). Each has its benefits and drawbacks, but they can radically improve air quality and significantly reduce heat loss.

With improved insulation won't I be too hot in summer?



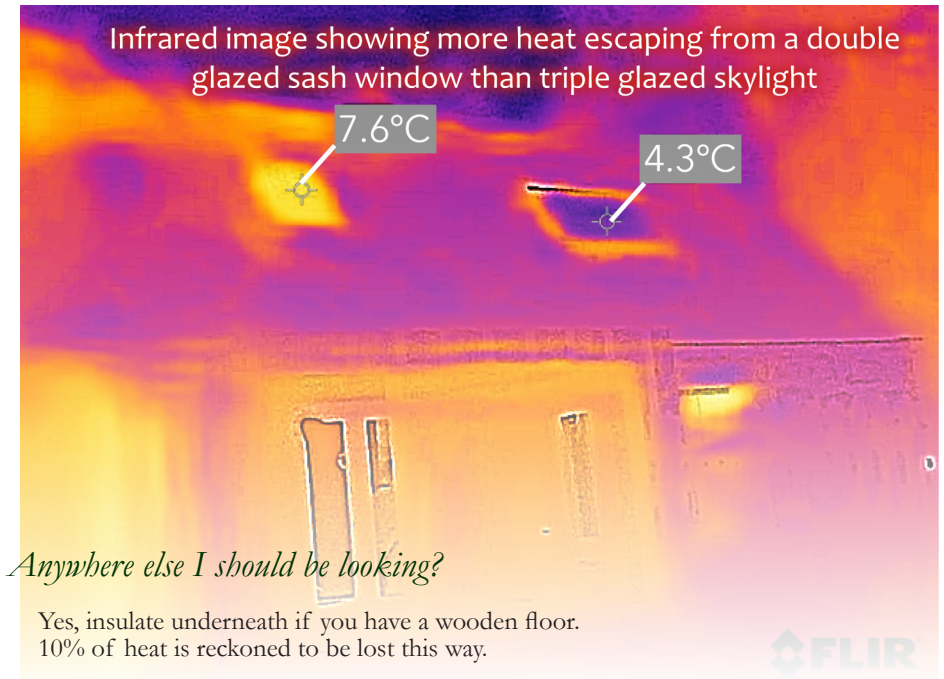
Solar gain, the free heat from the sun which the house traps, is a boon - we need the central heating less; however, a well insulated building may overheat in summer if solar gain is not considered when planning.

This isn't a reason to justify not insulating! In fact, well insulated buildings put less load on the air conditioning in hot climates.

Overheating risk can be reduced with external shading of south facing windows, by thoroughly lagging hot water pipes and by using energy efficient appliances.

What about my windows?

Triple glazing is the way to go but if your double glazing is sound, it's not a priority.



Anywhere else I should be looking?

Yes, insulate underneath if you have a wooden floor. 10% of heat is reckoned to be lost this way.

Do I need planning consent?

Depending on the work, planning consent or building warrant may be needed.

Are there standards for retrofitting homes?

PAS2035 is the British Standard which provides a consumer charter, a code of conduct for the industry and a code of practice for the installation of energy efficiency measures. It provides accountability and quality control so that what the householder decides is delivered.

A key part of the process is the appointment of a Retrofit Coordinator for each project (see below). They ensure that work is carried out to the accompanying PAS2030 installation standard for contractors. The PAS2035 standard works with TrustMark, a UK government endorsed quality register which hopefully the Scottish Government will adopt. All retrofit plans and installations are logged on Trustmark's database. These can be seen by building surveyors, hence allowing them to be included in property valuations. If the house is sold, future owners can then complete the retrofit plan, further adding value.

A guide to retrofit:

<https://www.trustmark.org.uk/docs/default-source/retrofit/a-guide-to-retrofitting-your-home.pdf>



Planning and implementing a retrofit

1. Set your ambitions

Decide what level of energy efficiency you want for your home taking into account your budget and the potential disruption. This will help you determine whether your plan is carried out all at once or step-by-step.

2. Get advice

You can do it all yourself but a qualified Retrofit Assessor/Co-ordinator or specialist architect can reduce much of the stress. Working to PAS2035 ensures quality. The key to good retrofit is planning and design. Typically homeowners seek advice from installers who seldom understand the complex interactions between the different elements; a piecemeal approach can lead to problems. A full retrofit assessment will cost much the same as a home report.



3. Get a proper energy assessment

An important step. The current EPC energy assessment is a blunt tool. Instead a full energy assessment includes measuring rooms, appraisal of structural issues, inspection of all insulation, assessment of ventilation and the use of a thermal camera.

4. Understand your options

The retrofit assessor will lay out all the options for upgrading the home, break down the upfront cost, the energy cost saving and the carbon cost-effectiveness for the home owner to consider.

5. Make a plan

The order in which energy efficiency measures are installed is very important and hinges around the fabric first approach. It is best that energy demand is reduced before the heat source is changed. If you've got a Retrofit Coordinator they will write a Medium Term Retrofit Plan for you.



6. Design

The design should be holistic. How each element (insulation, framing, stonework, pipes etc.) relates to the others is critical if problems are to be avoided.

7. Installation

The new retrofit standard requires that installations are carried out by a PAS2030 main contractor. If you project manage the work yourself it's worth considering a main contractor to alleviate stress and disruption. They can ensure that multiple trades work closely together to carefully implement the intended design.



Art by Annie Grant

8. Patience

As the standard is new, there is a shortage of professionals trained to PAS2035 and tradespeople trained to PAS2030.

It is expected that further funding from government will be needed to comply with PAS2035, so if you know professionals and tradespeople who may be interested in this then please contact Udny Climate Action or Zero Carbon Daviot. We are hoping to build a network of interested parties to pool training and increase the number of retrofit co-ordinators and trades people working to the new standards.

Money, Money Money!

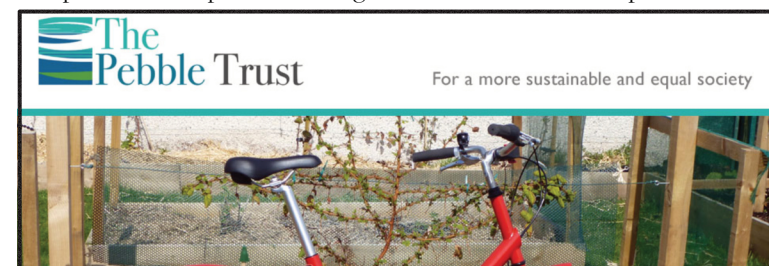
The overall cost of retrofitting will depend on-

- the level of energy efficiency you want for your home.
- the grants and loans available at the time(s) the work is undertaken.
- by how much the work undertaken increases the value of your home.

A whole house retrofit may only fully repay itself over a long period but it will be a more comfortable and healthy environment to live in with a low carbon footprint.

Sustainable Renovation Guide:

<https://www.thepebbletrust.org/sustainablerenovation.asp>



Heat pumps- what are they?

Before considering heat pumps, we need to look at other low carbon options for heating our homes:

All electric systems

The more the grid decarbonises, the more electric heating can be considered low carbon. An 'all electric house' will have:

- a boiler with an immersion heater for hot water.
- panel or oil filled radiators or modern storage heaters.

With these systems 1kw of electricity provides 1kw of heat (100% efficiency).

As long as the price of electricity is high, electric radiators will be expensive to run but they become a realistic option in a fully insulated home.

Much cheaper to run are storage heaters using electricity on low night time tariffs. With digital timers, heat can be used to best effect.

Biomass

Scottish Government policy only supports biomass (wood, bioheating oil and bio-propane) as a replacement for fossil fuels in off-gas grid areas where electric heating or heat pumps are unsuitable for a property.

Heat Networks

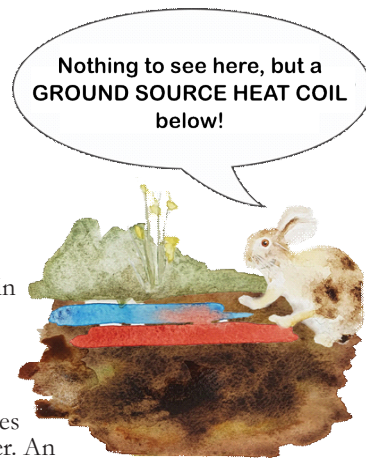
Heat networks involve a number of houses having a communal low carbon heat source such as a ground source heat pump or a biomass boiler. Such systems may be suitable for some places in the NE.

Heat pumps: a Q & A

How do heat pumps work?

They transfer heat from one place to another using the same principle as a fridge.

- Ground source heat pumps chill an antifreeze solution down to around 4°C.
- This water is circulated through a closed loop pipe in a borehole or in loops of pipe buried in trenches where the surrounding ground is at about 8°.
- The antifreeze solution has been warmed by the ground by the time it returns to the heat pump.
- This then re-chills the water and, in so doing, releases heat for the central heating system and for hot water. An air source heat pumps works on broadly the same principles but extracts heat from the air.



How does a fridge release heat? The refrigeration cycle uses a compressor that releases heat (think of pumping a bike tyre) and then uses an expansion valve which lets the liquid expand (same as the cooling you feel when using a tin of aerosol deodorant).

Do I have to get a heat pump?

No but the Scottish Government considers them to be the best low carbon system for homes off the gas grid. Oil and LPG boilers will be phased out in due course.

I've already got radiators, can they be used?

The house can be warmed via radiators but, because heat pumps work at a lower temperature than other forms of heating, larger radiators may be needed.

I've got underfloor heating, what's the score?

Underfloor heating is ideal for use with a heat pump costing less to run than radiators.

Will they heat my hot water too?

Yes but the system needs a hot water tank.

Why are heat pumps considered to be low carbon?

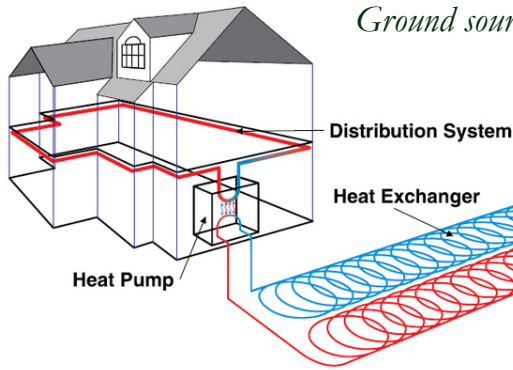
Here's the clever bit. They do require electricity to run but they produce considerably more energy as heat than the energy as electricity needed to run them. This differential is called the Coefficient of Performance (CoP). Most air source heat pumps will have a CoP of around 3 (300% efficiency). Ground source heat pumps are even more efficient (CoP 5+). In the North East, electricity now comes mainly from renewables.

The N.E. can get chilly!

In colder weather, a heat pump needs to work harder. This is where ground source scores over air source as ground temperature fluctuate less. Either way, if the house is well insulated and the correct size of pump is installed, you should be cosy all winter.



Ground source? Air source? What's the difference?



Ground source
Heat is extracted either via pipes laid horizontally a few feet underground or via vertical bore holes. The former requires an area of ground two or three times that of the house. Bore holes only require a small space. Either way, access is needed for machines to undertake the work. Once complete, the ground is restored.

Air source

This requires a unit with fans situated by the side of the house.

Ease of installation-

air source is easiest, although ground source is often not difficult either.

Room needed for equipment inside-

the air source boiler *etc.* can fit in a cupboard, ground source needs space in a utility room or the like.

Cost of installation-

air source costs less to install.

Cost to run-

with a higher Co-efficient of Performance, ground source is cheaper.

Replacement-

both will last a long time but the air source unit will need replacing sooner.

External noise-

an air source makes a low whirring sound; ground source is silent.



A wall-mounted air source pump

Do I need planning consent?

No, barring a few exceptions, but check with the Local Authority.

What are the implications of heat pumps running at lower temperatures?

The system takes longer to heat up than oil or LPG so the timer needs to be set to take account of this. A well insulated house will heat more quickly. There isn't a risk of legionnaires disease as the system automatically heats the water above 60 degrees C on a regular basis.

Do they need to be serviced?

A simple service is needed annually.

Will it be cheaper to run than my oil or gas boiler?

Per kWh, oil is cheaper than LPG and LPG is cheaper than electricity. A well insulated house with a heat pump is likely to be cheaper to run than a poorly insulated house using oil or LPG. This underlines why a whole house approach is needed. Fuel costs are volatile and electricity may become relatively cheaper, particularly if the green levy is switched from electricity to fossil fuels. To get the best out of heat pumps and to reduce pressure on the grid, the 'heat demand' of some houses will need to be reduced significantly through improved insulation.

Further reading

<https://www.nationalgrid.com/stories/energy-explained/how-do-heat-pumps-work>



Funding a retrofit

Home Energy Scotland (HES) is the first stop for advice and funding. (N.B.- funding schemes are changed from time to time)

Home Owners

HES provides interest free loans and cashback for energy saving measures such as loft, wall and floor insulation and double glazing as well as for heat pumps.

Example of HES funding in 2022.

	Heat pump	Internal/external wall insulation
Interest free loan + cashback: maximum -	£10,000	£10,000
of which cashback (grant): maximum -	£7,500	£4,000

Other technologies qualifying for HES funding include-

- Solar PV panels
- Solar water heating
- Electric or heat batteries.

Warmer Home Scotland

Full cost grants plus loans are available for a range of measures for carers, people with disabilities and older owner occupiers or tenants who meet certain criteria.

Information available from HES;

Private Rented Sector Landlord Loan Scheme

Available from HES for various measures.



Small and medium-sized enterprise (SME), not-for-profit organisations, and charities.

Loans (up to £100k) and cash back (up to £20k) are available for these organisations for energy efficiency initiatives and low carbon heating systems via Zero Waste Scotland.

<https://energy.zerowastescotland.org.uk/SMELoan>



Other funding;

- Funding may be available from utility companies or through the Energy Company Obligation scheme. HES can advise.
- A few financial institutions support retrofitting, such as the Ecology Building Society (mortgages for retrofitting: <https://www.ecology.co.uk/>). More may follow if the government encourages low interest loans.

QR code links for others mentioned in the booklet:



Zero Carbon
Daviot



Udney Climate
Action



Udney Community
Trust



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Home Energy
Scotland



Aberdeenshire
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Private
Landlord Loan